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MANAGEMENT OF VASCULAR WILT OF LENTIL THROUGH AQUEOUS PLANT EXTRACTS IN TARAI REGION OF UTTARAKHAND STATE

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ABSTRACT

Lentil wilt caused by *Fusarium oxysporum* Schechet. Emend. Snyder and Hansen f. sp. *lentis* Vasudeva and Srinivasan is an important disease and it is a limiting factor to lentil production. The present work aimed at evaluating the antifungal activity of some plant extracts *in vitro* and *in vivo* condition. Field experiments were conducted at N. E. Borlaug Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar. Field trials were carried out consecutively during *Rabi* 2010-11 and 2011-12 crop seasons in Randomized Block Design (RBD) with three replications, using 'Pant L-639' a released cultivar to wilt. The plot size was $3.0 \times 1.5 m^2$ with row spacing of 30cm. On the basis of *in vitro* studies, effective plant extracts were used for seed treatment. Effect of selected plant extracts on disease incidence, 1000 grain weight and yield of lentil was recorded. All the botanicals were observed effective. However, garlic extract seed treatment followed by ginger, showed lowest disease incidence, highest grain yield as well as maximum 1000-grains weight in comparison to check plot. The reduction in the pathogen population/ growth, decreased disease incidence and increased grain yield indicates that these extracts could have important roles in biologically based management strategies for control of *Fusarium* wilt disease under organic mode of lentil cultivation.

INTRODUCTION

Lentil wilt is one of the most widespread and destructive diseases caused by *Fusarium oxysporum* Schechet. emend. Snyder and Hansen f. sp. *lentis* Vasudeva and Srinivasan (Fol). The disease may cause complete crop failure under favourable conditions for disease development and can be the major limiting factor for lentil cultivation in certain areas (Chaudhary and Amarjit, 2002). In *Tarai* region of Uttarkhand state lentil wilt is a major problem. Plant diseases are mostly controlled by chemical pesticides and in some cases by cultural practices. However, the widespread use of chemicals in agriculture has been a subject of public concern and scrutiny due to the potential harmful effects on the environment, their undesirable effects on non-target organisms and possible carcinogenicity of some chemicals (Cook and Baker, 1983). Plant extracts is recently advocated by several researches, as a potential control method of plant diseases (Belabid *et al*., 2010). Many plant products have been reported to have antimicrobial activities against plant pathogenic root fungi (Bashar and Baharat, 1992; Bowers and Locke, 2000a). Keeping in view the drawback of chemical management of plant diseases, the use of plant extracts under organic mode of lentil cultivation in the management of plant diseases is gaining importance (Joseph *et al*., 2008).Thus the present study was conducted to evaluate the effect of aqueous plant extracts for the management of wilt of lentil. Since the use of natural products for the control of fungal diseases in plants is considered as an interesting alternative to synthetic fungicides due to their less negative impacts on the environment as well as they are economically feasible (Cao and Forrer, 2001).

MATERIALS AND METHODS

Evolution *in vitro*

Preparation of plant extract

The extract of garlic, ginger, eucalyptus, neem, coriander, onion and oak were tested on mycelia growth of *Fusarium oxysporum* f. sp. *lentis*. The extracts are prepared from bulbs and leaves, which are known as antifungal. Fresh leaves were washed under tap water followed by sterilized water the leaves were air dried and grinded with the help of pestle and mortar by taking (1:1 w/v) one gram of extract was added in 1 mL distilled water separately for each plant extract and filtered through muslin cloth and 100% plant extract solution was prepared. The extracts were poured in the flasks plugged with cotton and heated at 100°C for 10 minutes to avoid contamination (Madavi and Singh, 2005).

Evaluation of inhibitory effect of plant extracts on radial growth

The inhibitory effect of plant extracts on mycelium growth of pathogen was tested on potato dextrose agar medium by poison food technique (Nene and Thapilyal, 2000). Desired quantity of plant extract was prepared and added to sterile and molten PDA so that the final concentration in amended medium was 10, 20, 30 and 40%. Medium amended with desired concentration of selected botanicals was poured into sterilized Petri plates. For each concentration of botanicals,

Table 1: Efficacy of desired concentrations of botanicals on radial growth of *Fusarium oxysporum* f.sp. *lentis*, 24 h after incubation at 27 ± 1ºC

Botanicals/ Concentrations (%)	Radial growth (mm)*								
	10.0%	Reduction in radial growth (%)	20.0%	Reduction in radial growth (%	30.0%	Reduction in radial growth (%)	40.0%	Reduction in radial growth (%)	Mean
Garlic	7.7	35.83	7.0	41.66	5.3	55.83	4.3	64.16	6.07
Ginger	8.0	33.33	7.3	39.16	6.7	44.16	5.3	55.83	6.82
Neem	8.7	27.5	8.0	33.33	7.7	35.83	6.3	47.5	7.67
Eucalyptus	9.3	22.5	9.0	25	8.3	30.83	6.7	44.16	8.32
Coriander	9.7	19.16	9.3	22.5	8.3	30.83	7.3	39.16	8.65
Onion	10.3	14.16	9.5	20.83	8.7	27.5	8.0	33.33	9.12
Oak	11.3	5.8	10.3	14.16	9.7	19.16	8.7	27.5	10.0
Check	12.0	_	12.0	_	12.0	_	12.0	_	12.0
Mean	9.62	_	9.05		8.33	–	7.32	–	8.58
			Concentrations		Botanicals		Interaction		
S.Em. ±			0.12		0.16		0.33		
CD(P = 0.05)			0.36		0.47		0.96		
CV (%)		7.22							

*Mean of three replications

Table 2: Efficacy of desired concentrations of botanicals on radial growth of *Fusarium oxysporum* f.sp. *lentis*, 48 h after incubation at 27 ± 1°C

Botanicals/ Concentrations (%)	**Radial growth (mm)***								
	10.0%	**Reduction in radial growth (%)**	**20.0%**	**Reduction in radial growth (%)**	**30.0%**	**Reduction in radial growth (%)**	**40%**	**Reduction in radial growth (%)**	**Mean**
Garlic	14.0	53.33	13.0	56.66	10.3	65.66	9.3	69.0	11.65
Ginger	16.3	45.66	15.0	50	13.3	55.66	10.7	64.33	13.82
Neem	19.0	36.66	18.0	40	17.0	43.33	15.0	50.00	17.25
Eucalyptus	20.7	31	19.7	34.33	18.3	39.0	17.0	43.33	18.92
Coriander	22.0	26.66	22.3	25.66	20.3	32.33	19.0	36.66	20.9
Onion	24.0	20	22.3	25.66	20.7	31.0	19.3	35.66	21.57
Oak	24.0	20	23.3	22.33	21.7	27.66	20.0	33.33	22.25
Check	30	_	30	_	30	_	30	_	30
Mean	21.25	_	20.45		18.95	–	17.53	–	19.54
			Concentrations		Botanicals		Interaction		
S.Em. ±			0.25		0.34		0.68		
CD(P = 0.05)			0.72		0.96		1.93		
CV (%)		6.53							

*Mean of three replications

three replications were maintained. After solidification of medium, the plates were centrally inoculated with 5mm disc of fungus cut from edge of a fully grown culture with the help of sterilized cork borer. Non-amended PDA plates, inoculated with test pathogen, served as a control. All the inoculated plates were incubated at 27 ± 1ºC. Per cent inhibition over control was also calculated by applying the formula.

Field trails

Experiment was conducted during *Rabi* 2010-11 and 2011-12 crop seasons, respectively in RBD with three replications. Plot size was 3.0 × 1.5m^2 with 30 cm inter row spacing and sowing depth 3-4cm. Seeds of 'PL-639' were sown on 23 November during both the crop season. On the basis of *in vitro* studies, effective plant extracts were tried for seed treatment. Untreated seeds were sown as control. Observation of disease incidence, grain yield per plot and 1000 grain weight were recorded during both the crop seasons.

RESULTS AND DISCUSSION

Efficacy *in vitro*

All the tested plant extracts were more or less inhibitory to radial growth of the pathogen (Table 1, 2 and 3**).** Presence of plant extracts affected the normal growth of the test fungus. Plant extracts or plant essential oils have been tested against *Fusarium oxysporum* species for the inhibitory effect (Bowers and Locke, 2000a; Sahayaraj *et al.*, 2006). The effectiveness of the extracts increased with an increase in concentration and maximum inhibition was recorded at 40%. Greater inhibition of fungal growth was observed at higher concentrations of the crude water extract where as the lower concentrations supported the average mycelia growth rate per day (Joseph *et al.,* 2008). Significantly, the highest inhibition of radial growth was recorded in plant extracts from garlic extract (70.2%). The next best plant extracts were from ginger (63.6%) followed by neem (53.4%) and eucalyptus

Table 3: Efficacy of desired concentrations of botanicals on radial growth of *Fusarium oxysporum* f.sp. *lentis*, 72h after incubation at 27 ± 1°C

Botanicals/ Concentrations (%)	Radial growth (mm)*								
	10.0%	Reduction in radial growth (%)	20.0%	Reduction in radial growth (%)	30.0%	Reduction in radial growth (%)	40%	Reduction in radial growth (%)	Mean
Garlic	18.3	53.43	16.7	57.50	14.3	63.61	11.7	70.22	15.25
Ginger	22.0	44.02	19.0	51.65	16.3	58.52	14.3	63.61	17.9
Neem	24.0	38.93	20.3	48.34	19.3	50.89	18.3	53.43	20.47
Eucalyptus	26.0	33.84	23.3	40.71	21.0	46.56	20.0	49.10	22.57
Coriander	27.0	31.29	26.0	33.84	23.7	39.69	21.3	45.80	24.5
Onion	27.7	29.51	27.0	31.29	25.0	36.38	22.3	43.25	25.5
Oak	29.0	26.20	28.0	28.75	25.7	34.60	22.3	43.25	26.25
Check	39.3	–	39.3	–	39.3	–	39.3	–	39.3
Mean	26.66	–	24.95		23.07	–	21.18	–	23.97
			Concentrations		Botanicals		Interaction		
S.Em. ±			0.21		0.29		0.58		
CD(P = 0.05)			0.62		0.82		1.64		
CV (%)		4.61							

*Mean of three replications

Table 4: Effect of botanicals on wilt incidence, grain yield, 1000-grain weight during 2010-11 and 2011-12 crop seasons

Treatment	Dose (mL/kg seed)	Disease incidence (%)		Disease decline (%)		Grain yield (kg/ha)		1000-grain weight (g)		% increase over check	
		2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Garlic	10.0	1.33 (6.29)	1.42 (6.80)	75.78	75.30	528.3	511.7	14.7	14.5	35.8	36.1
Ginger	10.0	1.72 (7.49)	1.74 (7.71)	68.67	69.73	502.3	494.0	14.3	14.1	29.1	31.4
Neem	10.0	2.01 (8.13)	2.09 (8.13)	63.38	63.65	481.3	470.7	13.7	13.6	23.7	25.2
Eucalyptus	10.0	2.26 (8.72)	2.41 (8.91)	58.83	58.08	460.0	444.7	13.5	13.1	18.3	18.2
Check	–	5.49 (13.44)	5.75 (13.94)	–	–	389.0	376.0	10.9	10.4	–	–
S.Em. ±	–	1.40	1.80	–	–	8.82	5.73	0.95	0.19	–	–
CD(P = 0.05)	–	4.56	5.90	–	–	28.75	18.7	0.31	0.63	–	–
CV %	–	8.5	10.2	–	–	3.2	2.1	1.2	2.5	–	–

* Figures in parenthesis are angular transformed values

(49.1) 72h after incubation. In most report, the efficacy of plant extracts and plant essential oils has been evaluated only *in-vitro* and efficacy data in soil are lacking (Bowers and Locke, 2000b). It is evident from the results that all the plant extracts significantly inhibited the radial growth of the pathogen.

Efficacy *in vivo*

The data given in Table 4 revealed that all the treatments significantly decreased disease incidence, increased grain yield as well as 1000 grain weight as compared to check. During 2010-11 crop season, plots treated with garlic, recorded lowest disease incidence (1.33) followed by ginger (1.72) and neem (2.01). The highest grain yield (528.3 kg/ha) was recorded in garlic treated plots followed by ginger (502.3 kg/ha) and neem (481.3 kg/ha) while in check 389.0 kg/ha yield was recorded. Maximum 1000 grain weight (14.7g) was recorded in garlic treated plots followed by ginger (14.3) and neem (13.7g). Maximum decline in disease incidence (75.78 %) and increase in grain yield (35.8%) was recorded in garlic treated plots. During the crop season 2011-12, garlic treated plots again resulted lowest disease incidence (1.42) followed by ginger (1.74) and neem (2.09). Highest grain yield (511.7 kg/ha) and 1000 grain weight (14.5g) was recorded in garlic treated plots, while 376.0 kg/ha yield was recorded in check plot. Maximum per cent decline in disease incidence (75.30%) and increased in grain yield (36.1%) was recorded garlic treated plots.

Extracts of *Allium sativum* was found most effective against the pathogen both in *in vitro* and *in vivo* condition. The results were supported by Sahayaraj *et al*., 2006. According to them, among three plant extracts, bulbs of *Allium sativum* L. (*Liliaceae*), seeds of *Annona squamosa* L. (*Annonaceae*) and leaves of *Vitex negundo* L. (*Verbenaceae*), methanol extracts of *A. sativum* bulbs could possibly be used for controlling this soil-borne fungus. Efficacy of garlic bulb extract and neem leaf extract, *in vitro* was also reported by Prasad and Naik (2003). The antimicrobial properties of garlic (*Allium sativum)* extracts successfully reduced the growth of *Aspergillus flavus*, *Curvularia lunata* and *Fusarium moniliforme* (Olusanmi and Amadi, 2009). Plant extracts belonging to twelve families (Russel and Mussa, 1977) and *Prosopis juliflora* (Raghavendra *et al*., 2002) were used to control *Fusarium*. Natural chemicals and their use for integrated plant protection is one of the focus of research workers all over the world (Kiran *et al*., 2006). The results of the present investigation are clear indication for the potential of plant extracts to control fungal pathogens. It is therefore, suggested that the natural plant extract as Garlic (*Allium sativum*), Neem (*Azadirachta indica*), Eucalyptus (*Eucalyptus globules*) and Ginger (*Zingiber officinale*) may be used in the management of wilt of lentil under organic mode of cultivation to give better results as they are biologically based and environmental safe alternatives. Moreover, botanicals are non-pollutive, cost effective, non hazardous

easily available do not disturb ecological balance

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